THE NETWORK MANAGER OF THE FUTURE

How to prevent headaches and heartburn

By Kevin Mills

What will the world of network management be like in the 1990s? Before we make an effort at serious prediction, let's consider a possible future scenario:

Awakened from a sound sleep, Owen S. Ingram, manager of MegaCorp.'s international integrated services network, finds the emergency message alarm flashing on his bedside communications center. Shaking the fog from his brain, Ingram mumbles, "This better be important," as he logs into the Megamail system. The directory shows several unread messages, but only one is flashing red. Still a bit groggy, Ingram scans the notice from the MegaCorp. network operations center. A major catastrophe appears to be forming in the Asian region. The network is partitioning, isolating Asia from the United States and Europe, just as the business day begins in the Pacific region. Ingram immediately connects to NetMinder, MegaCorp.'s knowledge-based network management expert system, entering voice interactive mode.

"Ingram here."

"Validated," replies NetMinder.

"What is the problem?" inquires Ingram.

NetMinder reports, "Data traffic cannot transit major backbone segments into or out of Asia, through Europe or the United States. Voice circuits can still be established. Data traffic bound to and from Asia flows to Africa and South America, where messages disappear. Preliminary analyses indicate that network packet switches have obtained and are spreading faulty routing information."

"Go on," prompts Ingram, unimpressed.

"Routing tables retrieved from several key packet switches verify the existence of bad routes," continues NetMinder. "Test voice circuits established through our PBXes provide paper connectivity."

"What do you recommend?" asks Ingram.

"Two courses of action are advised. First, inject static routing tables into interdomain packet switches, setting the dynamic routing updates to test mode only. The static routes will provide switched circuit paths through our PBXes into and out of Asia, reducing voice capacity by about 25%. The missing capacity can be recovered through planned backup service from public telephone carriers.

"Second, begin tests to identify and isolate the source of bad routing information," concludes NetMinder.

"What tests are recommended?" insists the boss.

"The bad routing information must originate from one of our interdomain routing agreements. Preliminary analysis identifies three suspects: one, our Asian subsidiary MegaEast; two, the South African Telephone Network through which we route all messages bound for African destinations; and three, the Brazilian Telenet subsidiary that provides an alternate entry and exit for our South American data traffic. The test will consist of isolating each suspect fault source in turn, clearing dynamic route information in our packet switches. A trace of routing updates should locate the fault source."

"Reconfigure the backup circuits now," orders Ingram, "and initiate tests to find the dynamic routing faults. Remember that a number of faults may be found.

"How long will the tests take?" asks a sleepy Ingram.

"Four to six hours," responds NetMinder.

"Send me an emergency notification upon completion," commands Ingram, turning back toward bed.

Arriving at work, Owen Ingram skips his normal morning pleasantries and connects to NetMinder. While waiting for results from the dynamic routing tests, Ingram decides he will verify the proper oper-

A vast network run by one man and an expert system?

ation of the backup reconfiguration installed by NetMinder last night. The network elements seem to be operating okay, except that the interdomain boundary nodes are set to test mode. Queries to NetMinder verify resource utilizations within tolerable ranges on all components. All data and voice traffic into and out of Asia is flowing with normal quality, although the cost of the service is up sharply.

Complex global telecom networks will proliferate

Before Ingram can investigate some ideas for fine tuning the cost performance ratio of the trans-Asian routes, an emergency notification arrives from NetMinder. The dynamic routing tests are complete. Switching to voice interactive mode, Ingram identifies himself and asks for a report.

"Faulty routing information originates across the interdomain link with the South African Telephone Network. This is a single failure of unknown cause," reports NetMinder.

"Recommended solution?" asks Ingram.

"The South African Telephone Network is outside MegaCorp. control. Breaking the interdomain routing connection with South Africa is the only solution. This will result in restoring dynamic routing service within the remainder of the MegaCorp. network, but will prevent data traffic to and from Africa."

After a few minutes' thought, Ingram commands NetMinder to break the interdomain routing link to South Africa. Ingram, recalling a backup satellite packet-switching network installed some years back, orders NetMinder to reconfigure African data traffic routes using satellite transmission.

"Report status when complete," barks Ingram, making a note to arrange a meeting with South African Telephone representatives concerning reestablishment of a new interdomain routing agreement.

"Reporting reconfiguration complete," drones NetMinder. "The quality and cost of the reconfigured African routes are within MegaCorp. limits, but coverage through the satellite network is only 65% of normal."

Ingram makes a final request of NetMinder: "Inform the major message centers of the situation, and request that they relay loss of service information to uncovered sites through appropriate internal country channels. Also request that they make temporary arrangements to act as relay points using any available leased or dialed telephone circuits. Monitor the situation as it evolves and prepare a network connectivity diagram for our new African network."

Back To Reality

A global network managed by a single man with the aid of an expert system? Not in your lifetime, you say? Maybe not, but some trends are clearly leading us into a future where such advanced network management techniques and facilities are not only possible, but necessary.

Today, as our flight of fancy reveals, we can already foresee the network environment of the late 1990s. Corporate networks of international scope will abound. The networks will not be built from facilities wholly owned by a single organization; therefore, multiple administrative domains will be encountered.

The network will not be clearly separable from the users it serves, as communications and computing continue to blur. Heterogeneity will enter all parts of the network, in such forms as multiple vendor equipment, various protocol suites, mixes of public and private transmission facilities, coexistence of packet and circuit switching, expansion of local-area networks into metropolitan networks, and a multitude of regulations and legislation unique to specific countries. Network end points will move as people travel around the world yet still expect to be accessible.

These factors foretell a mammoth increase in complexity. The number and value of the resources involved will be staggering. Availability of a reliable service of high quality will be more essential than ever before.

The variety of network applications won't change, but the volume of information will increase, as will the number of users. The two biggest uses of data networks will continue to be business data interchange and electronic mail. As the number of automated offices increase, interchange of documents will grow. A rise in the number of graphic workstations will lead to vast increases in diagrammatic traffic. As these bulk data transfer applications grow, the use of file transfers will follow.

Due to user delay expectations, remote log-on services will remain restricted to limited geographic areas supported by local networks. An exception is remote database access. The number of on-line directories and information bases will grow as information becomes a more valuable resource. Such repositories will be compiled and supplied by commercial firms, requiring remote terminal access across wide geographic areas.

The use of geographically distributed processing resources will not increase appreciably. Improved affordability of computers limits the need for resource sharing. An exception is the sharing of supercomputers. Supercomputers are expensive enough that establishment of a limited number of resource centers is likely. Thus, transfer of jobs to, and results from, such centers is a likely use for networks in the 1990s.

Eventual implementation of integrated services digital networks (ISDN) may lead to new applications such as integrated teleconferencing. By integrating and synchro

nizing the display of video, voice, text, and graphics information, ISDN services may provide an alternative to physical travel for routine business meetings. Such services seem technically feasible, but their acceptance will depend upon changes in business behavior.

How To Prepare

The network manager is facing a period of increasing complexity, abundant heterogeneity, and enlarging responsibility. How can he prepare?

The best hope for managing the complexity is to limit the interoperability problems arising from heterogeneity. Adopt standards for network communication wherever possible. By selecting standards and demanding their implementation within products before you buy, interoperability problems may be reduced.

When a LAN or PBX includes a proprietary management system, insist upon adherence to a corporatewide standard for communications with the network operations center. And rather than setting your own corporate standard, which carries little weight with major vendors, support the development and adoption of international standards for Open Systems Interconnection (OSI) network management. Joining in the development of OSI management standards can help to ensure that they meet your needs. Adopting the results will add your corporate weight to that of many others, creating a market that will attract vendor attention.

As a second step, specify a minimum level of network management functions to be implemented in every product or by every service that you purchase. These specifications define the minimal level of network management meeting your needs. You must work so that emerging standards for network management enable such needs to be satisfied. Then buy network products that meet the standards. Taking this step after an international corporate network has evolved can be very costly.

As a third step, distribute the responsibility for network management. The method for distribution may be organizational or geographical, depending on the preferences and culture of the corporation. Two benefits accrue from distributing the responsibility. First, quality service demands that network management staff be located close to the users. Nothing unsettles a user more than dealing with a remote set of unknown faces concerning a problem that is very immediate and local. Second, with management responsibility divided, each section of the network gets more careful scrutiny. Thus, problems that are local or regional in scope can often be identified and fixed quickly without a central network operations center becoming aware immediately.

To support distributed management responsibility a coordinated hierarchy of "manager managers" must be implemented. The exact partitioning, again, depends on the needs of the organization. But the rules for coverage and precedence must be defined unambiguously. Standards must be established for the interoperation of manager-to-manager communications. The level of information needed as management traverses the hierarchy must be carefully assessed. Thoughtful design leads to collecting network information as the scope of management increases. But provision must remain for higher-level managers to take over for failed lower-level managers.

Rule-based expert systems show some potential for aiding in network management. As a first application, such systems may be applied to help in the diagnosis of network faults. The application of knowledge-based techniques to diagnosis is already demonstrated in medicine. Network fault diagnosis, though, presents some harder problems. The body of knowledge required to diagnose network troubles does not exist, and may never exist in the general sense. For each network, a unique body of knowledge must be derived and encoded. A general body of knowledge is well off in the future.

Because the control loop for network fault and performance evaluation and correction is so tight, a more promising immediate application of expert systems to network management may occur in off-line areas such as network design and capacity planning. Using a set of facts collected from slowly changing sources or from dynamic sources, an expert system may assist in selecting cost-effective design alternatives and network upgrades. As a result, a canned set of backup configurations and a threshold-activated set of network upgrades might be established for use as needed.

Headaches And Heartburn

In past years the IS manager was tabbed as the man with headaches and heartburn. Now computing has spread to user departments, easing pressures on the DP center to meet all processing needs in the corporation. The corporate focus today is on information as a resource.

The requirements for ready and efficient access to information are growing at just the time that communications deregulation changes the nature of telecommunications. These changes mean headaches and heartburn ahead for the network manager unless he plans for the late 1990s' network environment today.

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